## Dumping and Discharge Points

Figures 32 and 33 show the location and type of dumping and discharge points and anthropogenic debris found in the Snoqualmie River in 2000. Cars and car parts, tires, machine and metal parts, and various types of yard waste were identified. At several locations, an unknown liquid was discharging from pipes into the river or seeping into the river. These are potential point sources of pollution. Source tracing and educating the responsible landowners on best management practices (BMPs) will help to alleviate this problem. In general, visible water turbidity increased in the downstream reaches of the Snoqualmie River, especially between RM 6-11. Possible sources of this turbidity are runoff from agricultural land, urbanization, and algal growth.

## Miscellaneous Observations

Although this habitat inventory did not focus on identification of aquatic biota, the field team observed great blue herons (*Ardea herodias*), songbirds such as American robins (*Turdus migratorius*), tree swallows (*Iridoprocne bicolor*), and yellow-bellied sapsuckers (Sphyrapicus *varius),* and occasional bald eagles (*Haliaeetus leucocephalus*) using the riparian trees for roosting and perching. The field team also observed large concentrations of live freshwater mussel beds (*Margaritifera falcata*) at two locations: immediately downstream of Neal Road between RM 31-32, and immediately upstream of the City of Duvall between RM 11-12. Numerous cutthroat trout (*Oncorhynchus clarki clarki*) and whitefish (*Prosopium williamsoni*) were seen throughout the Snoqualmie River as well. Sockeye salmon (*Oncorhynchus nerka*) spawners were observed in two locations: near the Neal Road boat launch at RM 31.4 and near RM 18, where a female was observed building a redd. This finding was surprising because WRIA 7 is not known to support populations of wild sockeye salmon.

## Large Pools

Figures 34 to 36 show the locations of large pools in the King County portion of the Lower Snoqualmie River mainstem in the summer of 2001. In all, 70 large pools, at least as long as the river is wide, were recorded in the 35 mile reach between the mouth of the Snoqualmie River and the confluence of the Snoqualmie and Raging Rivers for an average of two large pools per mile. Many of these pools were several channel widths in length. The frequency of pools and the overall area of pool habitat suggest good rearing, refuge, and prespawning holding habitat for salmonids.

Table 4 indicates that 67 large pools were recorded between the King County line and the confluence of the Snoqualmie and Raging Rivers (RM 6-35) for an average of 2.3 large pools per mile. Between RM 6-35, the Snoqualmie River has five distinct morphological reaches. RM 6-13 is a deep and stable channel with little history of avulsion. This reach is called "County Line to Duvall" and has a very uniform, trough-like streambed with few distinct pools. In the summer of 2001, there were only 1.7 pools per river mile and the pool area (percentage of river area occupied by pools) was only 30.4%. The Snoqualmie River picks up increased gradient and velocity and has a uniform streambed as the river flows over the Tolt River delta, RM 22-25. The pool spacing in this reach was only 1.7 pools per mile, and the pool area was only 25.3%. The Raging River delta, RM 32-35, is also a reach of increased velocity and gradient, does not have a uniform streambed, and averaged 2.0 pools per mile. The percent pool area could not be calculated for this reach because tailout depths were not recorded for three of the six pools and therefore residual depths could not be determined. The two meandering reaches, near Duvall downstream of the Tolt River delta, and near Carnation between the Tolt and Raging River deltas, had nonuniform streambeds with frequent pools. The Duvall Meanders reach had 2.8 large pools per mile, with a 55.3% pool area. The Carnation Meanders reach had 2.7 large pools per mile, with fully 63.7% of the river area occupied by pools.

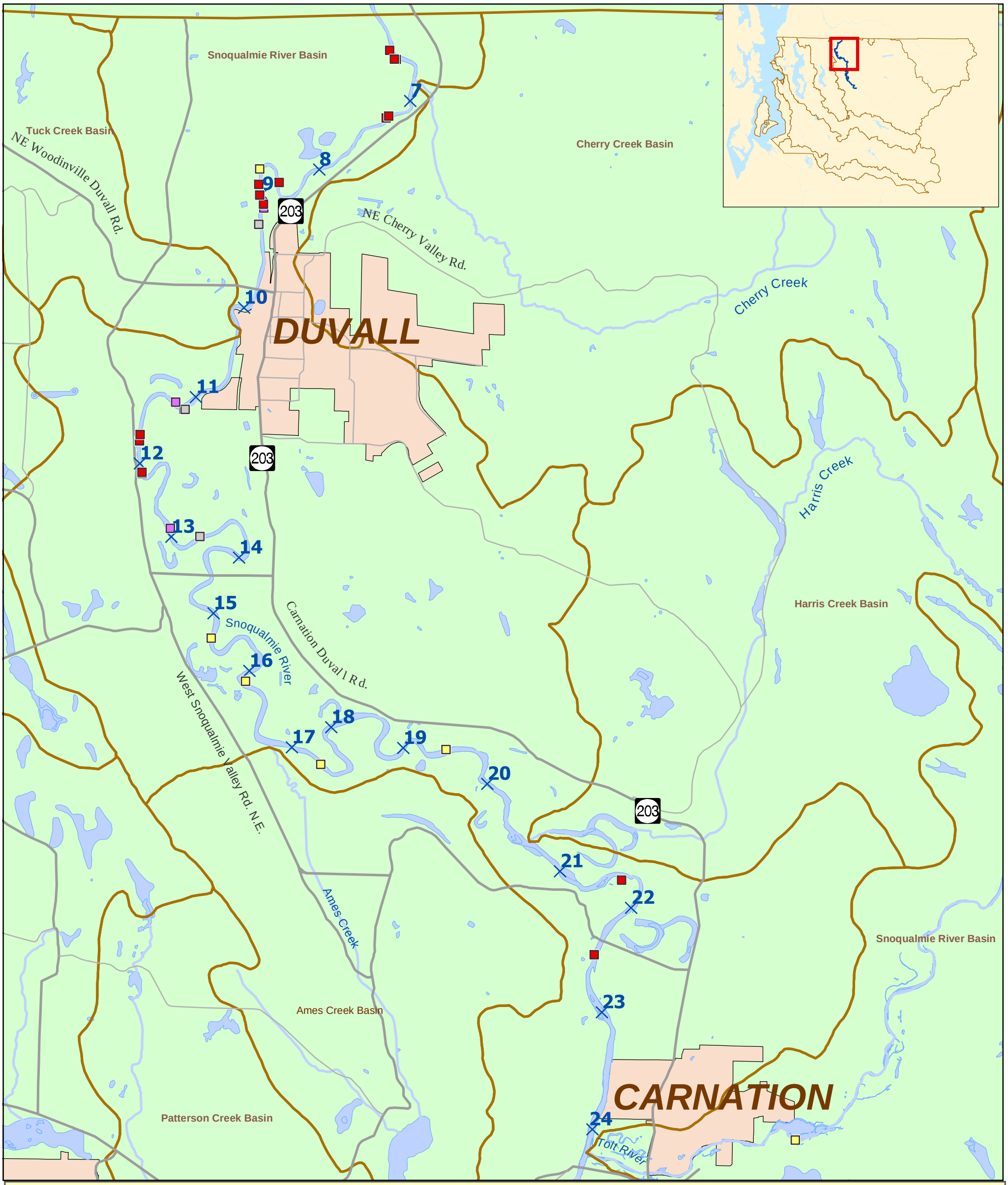


**Figure 32.**

# SNOQUALMIE RIVER SURVEY: Dumping Sites

*Map 1 of 2*

N

21 River Miles
Minor Roads
Major Roads
DNRP Basin Boundary
Incorporated Areas

CAR OR PARTS
YARD WASTE
UNKNOWN LIQUID
OTHER
TIRES

0 0.5 1 2 3 4 Miles

**King County**
Department of Natural Resources and Parks
**Water and Land Resources Division**

**DATA SOURCE NOTES:**
Erosional Features: KC DNRP & Washington Trout survey, 2000
Waterbodies: KC DNRP & WA DOE Hydrography Project, 1997
River Miles: Generated from waterbody routes in waterbody layer
Basin Boundaries: KC DNRP Basin Planning, 1997

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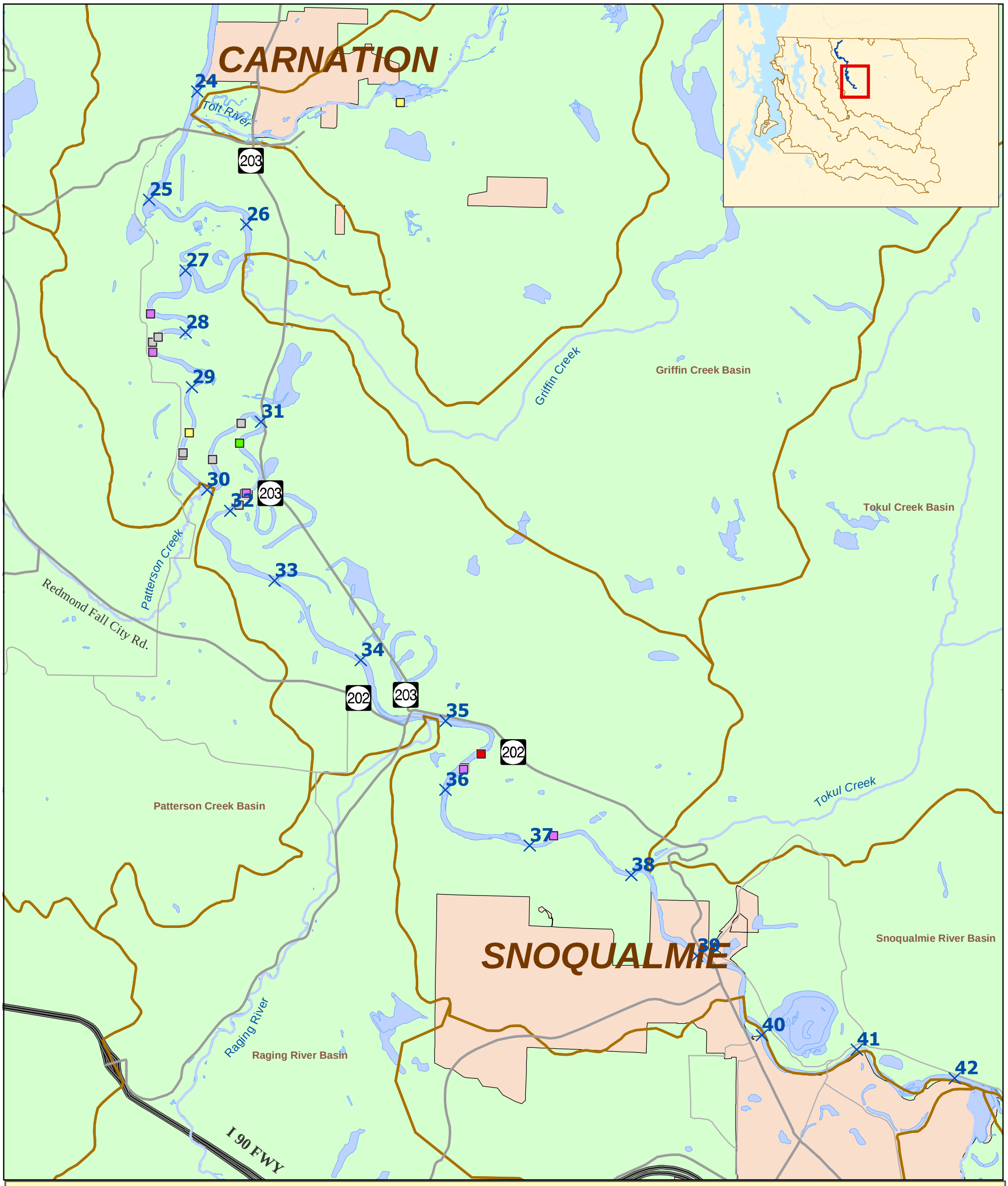


**Figure 33.**

# SNOQUALMIE RIVER SURVEY: Dumping Sites

*Map 2 of 2*

N

21 River Miles
Minor Roads
Major Roads
DNRP Basin Boundary
Incorporated Areas

CAR OR PARTS
YARD WASTE
UNKNOWN LIQUID
OTHER
TIRES

0 0.5 1 2 3 4 Miles

**King County**
Department of Natural Resources and Parks
**Water and Land Resources Division**

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Snoqualmie River Basin

Tuck Creek Basin

Cherry Creek Basin

NE Woodinville Duvall Rd.

NE Cherry Valley Rd.

DUVALL

203

Carnation Duvall Rd.

Snoqualmie River

6 20.7

7 18.4

7.7

8 6

9 11.9

10 9

8.5

11 13.9 6

12 18.8

9.5

13 11.9

9.9

11.2

14 24.5

24.7

15.8

15 9.2

13.5 12.9 10

16 13.2

10.2

15.2

17 7.2

18 13.8

13.1

11.7

19 18

16.4

17.4

Figure 34.

# SNOQUALMIE RIVER SURVEY: Location of Large Pools Map

*Map 1 of 3*

N

21 River Miles

Minor Roads

Major Roads

DNRP Basin Boundary

Incorporated Areas

11.9 Large Pools

(Residual Large Pool Depth Measured in Feet)

Major Streams

Open Water

0 .15 .3 .6 .9 1.2 Miles

**King County**

Department of Natural Resources and Parks
**Water and Land Resources Division**

**DATA SOURCE NOTES:**

Large Woody Debris: KC DNRP & Washington Trout survey, 2000
Waterbodies: KC DNRP & WA DOE Hydrography Project, 1997
River Miles: Generated from waterbody routes in waterbody layer
Basin Boundaries: KC DNRP Basin Planning, 1997

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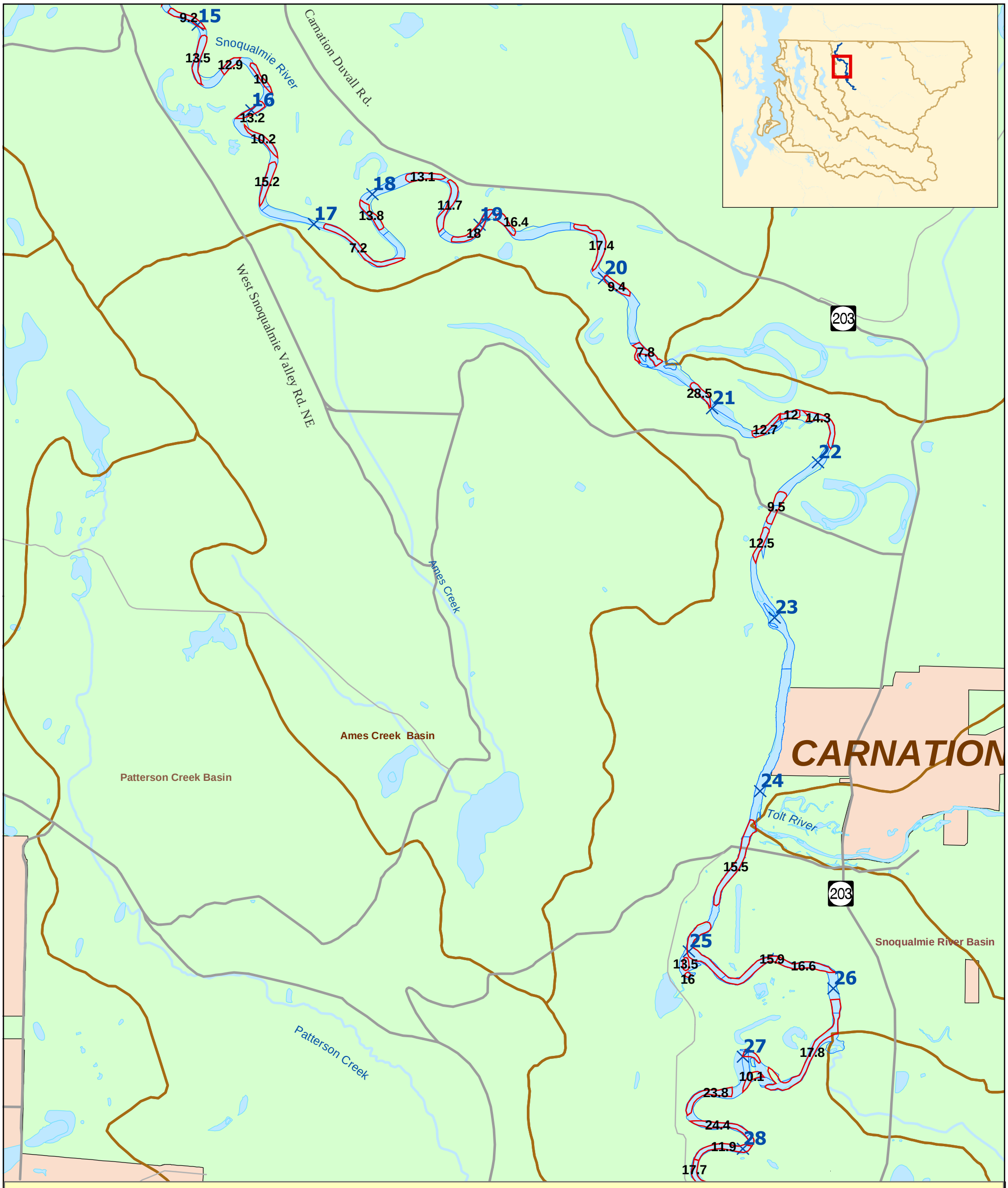
Figure 35.

# SNOQUALMIE RIVER SURVEY: Location of Large Pools Map

*Map 2 of 3*




N

21 River Miles

Minor Roads

Major Roads

DNRP Basin Boundary

Incorporated Areas

11.9 Large Pools

(Residual Large Pool Depth Measured in Feet)

Major Streams

Open Water

0 .15 .3 .6 .9 1.2 Miles

**King County**

Department of Natural Resources and Parks
**Water and Land Resources Division**

**DATA SOURCE NOTES:**

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27
17.8
10.1
23.8
24.4
28
11.9
17.7
9.7
19.5
29
15.3
31
8.1
10.4
24.5
13
15
30
14
0
203
32
17.5
0
0
33
13.6
Redmond Fall City Rd.
Patterson Creek
34
12
202
203
12
35
202
36
37
38
Snoqualmie River Basin
SNOQUALMIE
Griffin C
River

Figure 36.

# SNOQUALMIE RIVER SURVEY: Location of Large Pools Map

*Map 3 of 3*

N

21 River Miles

Minor Roads

Major Roads

DNRP Basin Boundary

Incorporated Areas

11.9 Large Pools
(Residual Large Pool Depth Measured in Feet)

Major Streams

Open Water

0 .15 .3 .6 .9 1.2 Miles

**King County**
Department of Natural Resources and Parks
**Water and Land Resources Division**

**DATA SOURCE NOTES:**
Large Woody Debris: KC DNRP & Washington Trout survey, 2000
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Residual large pool depth was consistent throughout the Snoqualmie River. Pools averaged 14.1 feet (4.3 meters) of residual depth, and ranged between 6.0 and 28.5 feet (1.8 and 8.7 meters). The average residual depth in the different morphological reaches ranged from 11.9 feet (3.6 meters) in the "County Line to Duvall" reach to 15.9 feet (4.9 meters) in the Carnation Meanders reach.

Two pools had a maximum depth of 30 feet (9.2 meters). Almost all of the pools were formed by scour along the riverbanks. A few pools were dammed behind accumulated sediment, such as just upstream of the Tolt River delta. None of the large pools had been formed by logjams.

**Table 4. Frequency, Residual Depth, and Area of Pools in Mainstem Snoqualmie River (RM 6-35) in Summer 2001**

| River Mile | Reach | Pools | Pools/ mile | Range Residual Depth Feet (meters) | Average Residual Depth Feet (meters) | % Pool area |
|---|---|---|---|---|---|---|
| 6-13 | County Line to Duvall | 12 | 1.7 | 6.0-18.8 (1.8-5.7) | 11.9 (3.6) | 30.4 |
| 13-22 | Duvall Meanders | 25 | 2.8 | 7.2-28.5 (2.2-8.7) | 14.1 (4.3) | 55.3 |
| 22-25 | Tolt River Delta | 5 | 1.7 | 9.5-16.0 (2.9-4.9) | 13.4 (4.1) | 25.3 |
| 25-32 | Carnation Meanders | 19 | 2.7 | 8.1-24.5 (2.5-7.5) | 15.9 (4.9) | 63.7 |
| 32-35 | Raging River Delta | 6 | 2.0 | 12-17.5 (3.7-5.3) | 13.8 (4.2) | N/A |
| **6-35** | **All** | **67** | **2.3** | **6-28.5 (1.8-8.7)** | **14.1 (4.3)** | **42.0** |

## Temperature

Temperature loggers recorded the water temperature at the bottom of deep pools at four locations in the Snoqualmie River every hour from July 14 to September 28, 2000, and at three locations in the Snoqualmie River every hour from June 26 to October 19, 2001. The exact locations are described in the Methods Section of this report.

Both hourly and average monthly water temperatures increased progressively downstream in both 2000 and 2001, with Duvall being the warmest and the Raging River mouth being the coolest (Figures 37 to 40, Tables 5 to 8). The difference between minimum and maximum monthly temperatures ranged from 5.3 to 6.6°C at each site in 2000 and from 2.7 to 7.5°C at each site in 2001 (Table 6). Since all temperatures were measured at the bottom of deep pools, these measurements may not depict actual average water column or surface temperatures.

**Table 5. Seven-Day Moving Average Temperature (°C) in Mainstem Snoqualmie River in Summer 2000 and Summer 2001**

| | 7-day moving average | |
|---|---|---|
| | **2000** | **2001** |
| Duvall | 20.5 | 17.2 |
| Tolt River Mouth | 19.8 | N/A |
| Neal Road | 19.2 | 16.5 |
| Raging River Mouth | 18.4 | 16.0 |

**Table 6. Minimum and Maximum Temperatures (°C) in Mainstem Snoqualmie River in Summer 2000 and Summer 2001**

| | **2000** | | | | | |
|---|---|---|---|---|---|---|
| | July 14 - 31 | | August | | Sept 1 - 28 | |
| | min | max | min | max | min | max |
| Duvall | 14.9 | 21.2 | 15.5 | 21.2 | 11.3 | 17 |
| Tolt River Mouth | 14.2 | 20.5 | 14.7 | 20.5 | 11.1 | 16.6 |
| Neal Road | 13.2 | 19.7 | 13.3 | 19.9 | 10.5 | 16.3 |
| Raging River Mouth | 12.7 | 19 | 13.4 | 19.2 | 10.5 | 15.8 |

| | **2001** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | June 26 - 30 | | July | | August | | September | |
| | min | max | min | max | min | max | min | max |
| Duvall | 12.4 | 15.7 | 13.3 | 19.5 | 13.9 | 20.8 | 12.5 | 18.5 |
| Neal Road | 11.6 | 14.3 | 12.6 | 15.4 | 13.3 | 20.8 | 11.2 | 17.6 |
| Raging River Mouth | 11.4 | 14.2 | 12.4 | 15.2 | 13.1 | 20.1 | 11.4 | 17.5 |

**Table 7. Average Temperature (°C) by Month in Mainstem Snoqualmie River in Summer 2000 and Summer 2001**

| | 2000 | | |
|---|---|---|---|
| | July 14 - 31 | August | Sept 1 - 28 |
| Duvall | 17.3 | 17.8 | 14.4 |
| Tolt River Mouth | 16.7 | 17.3 | 13.9 |
| Neal Road | 16.1 | 16.4 | 13.4 |
| Raging River Mouth | 15.8 | 16.1 | 13.2 |

| | 2001 | | | |
|---|---|---|---|---|
| | June 26 - 30 | July | August | September |
| Duvall | 13.7 | 16.7 | 17.7 | 15.6 |
| Neal Road | 12.8 | 15.4 | 16.6 | 14.4 |
| Raging River Mouth | 12.6 | 15.2 | 16.3 | 14.2 |

**Table 8. Number of Hours that Temperature ≥ 18°C in Mainstem Snoqualmie River in Summer 2000 and Summer 2001**

| | 2000 | 2001 |
|---|---|---|
| | hours at or above 18°C | hours at or above 18°C |
| Duvall | 393 | 469 |
| Tolt River Mouth | 317 | N/A |
| Neal Road | 175 | 171 |
| Raging River Mouth | 116 | 120 |

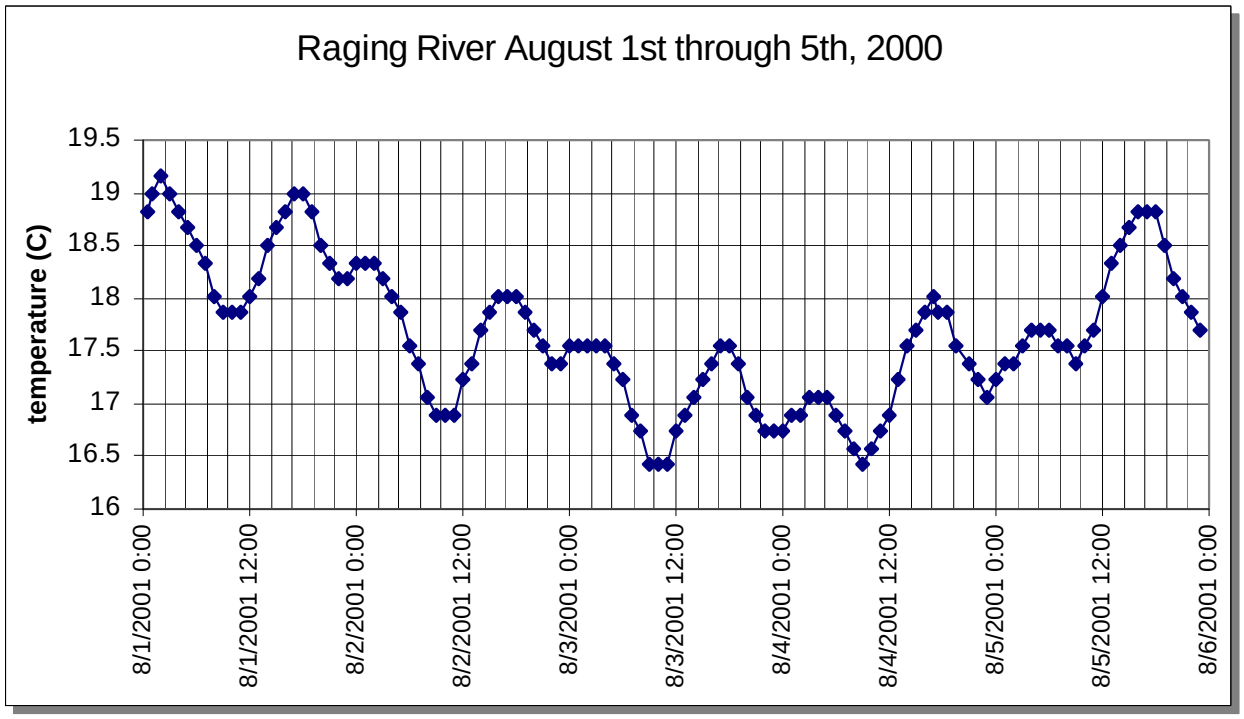


**Figure 37. Diurnal Temperature Measurements at Raging River Site, August 1-5, 2000**

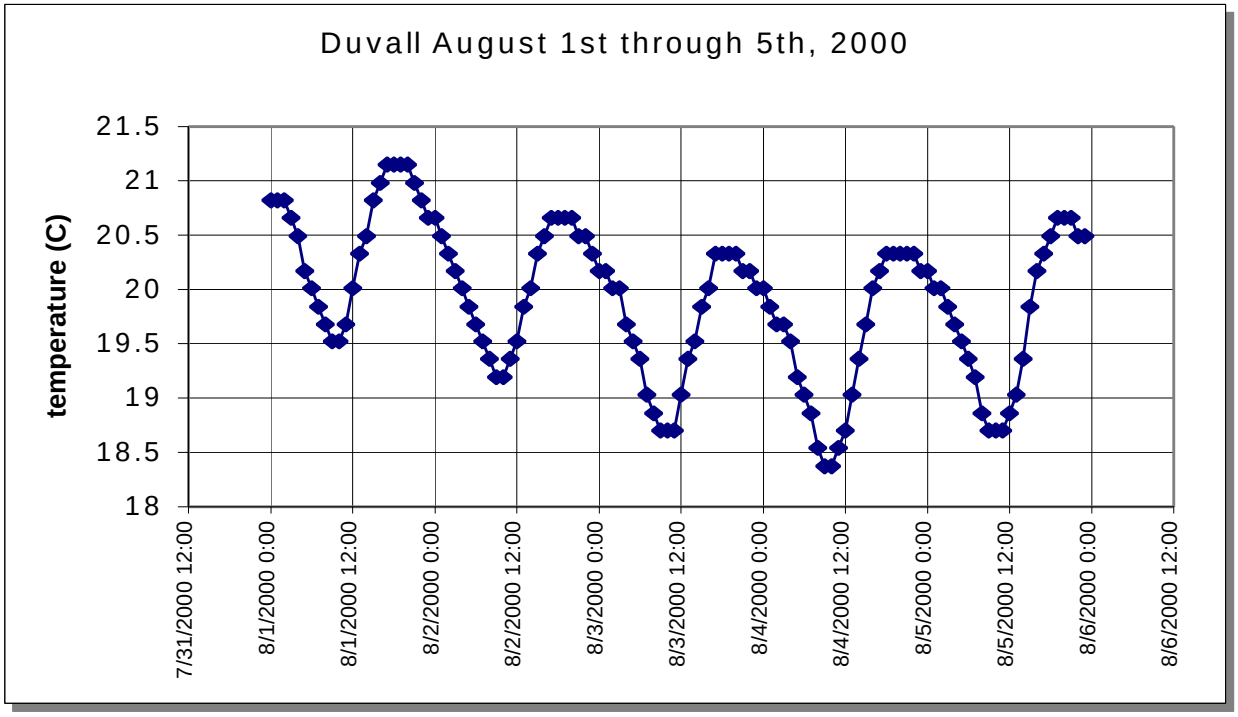


**Figure 38. Diurnal Temperature Measurements at Duvall Site, August 1-5, 2000**

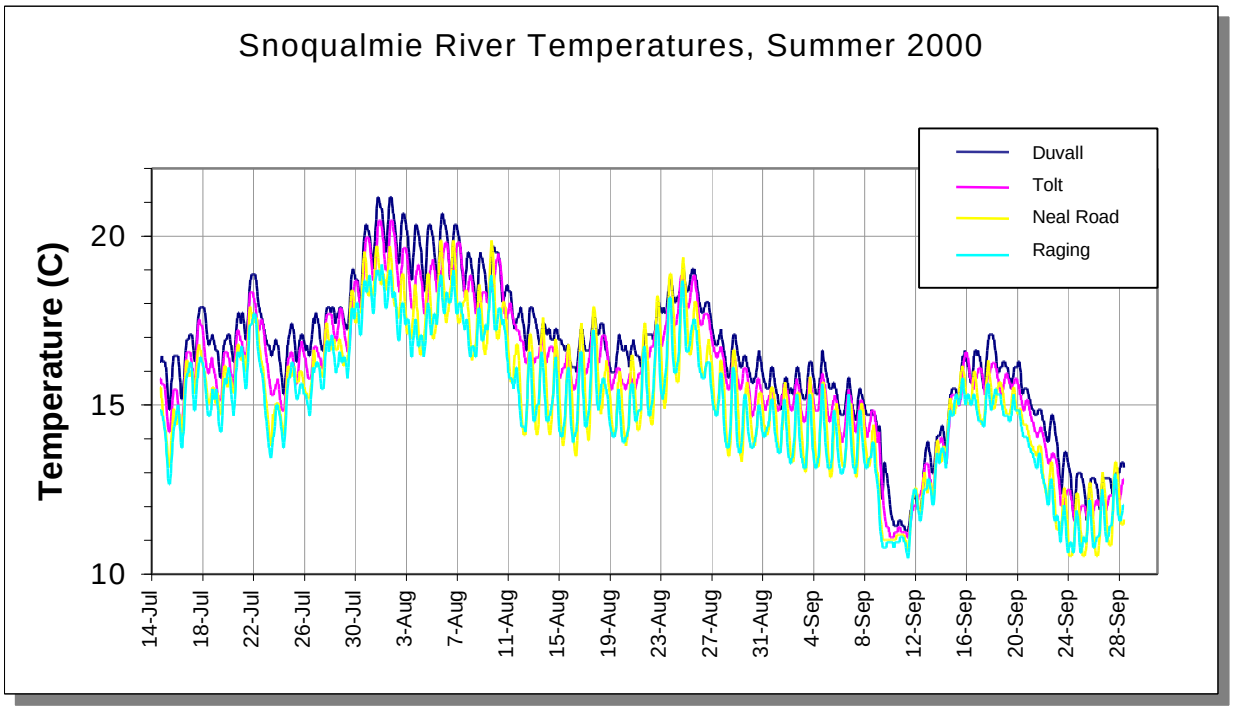


**Figure 39. Snoqualmie River Temperature Measurements, Summer 2000**

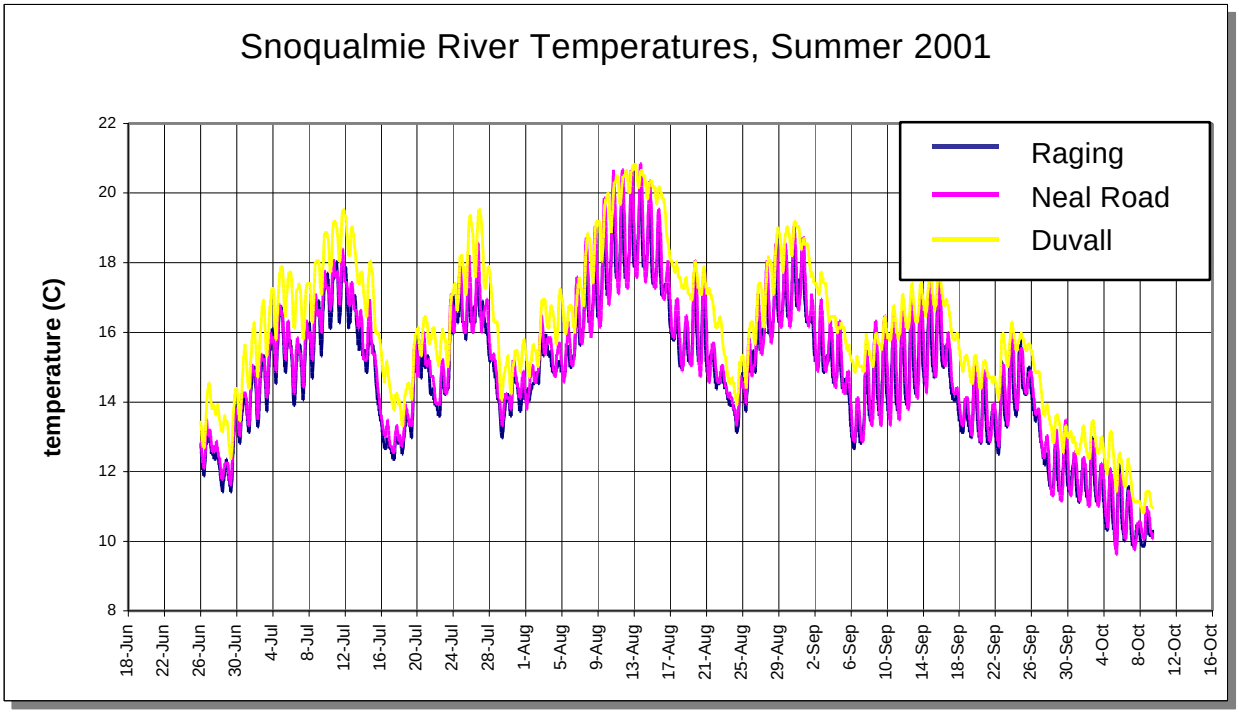


**Figure 40. Snoqualmie River Temperature Measurements, Summer 2001**

Examination of diurnal fluctuations in temperatures at each site revealed that the time for peak temperature differed at each site. The Raging River site peaked around 6 PM daily, the Neal Road site peaked around 5 PM daily, and the Duvall and the Tolt River sites peaked around 10 PM. These findings correlate with the water depth of the loggers. The Raging River and Neal Road temperature loggers were in only about 8 feet of water, while the Tolt River and Duvall loggers were in over 10 feet of water. The hottest time of the day for summer air temperatures is around 3 to 5 PM. It may be that water temperature on the surface peaks in the late afternoon and the warmer water slowly mixes with the bottom of the water column resulting in later peak temperatures registering on the loggers in the deeper pools.

The logger at the Raging River site showed two separate temperature peaks per day. The second, more minor peak occurred approximately 12 hours after the primary temperature peak. This second peak was only slightly noticeable on colder days, but was evident on warmer days. This pattern appeared at the Neal Road site as well, but was less evident than at the Raging River site.

The first week of August is statistically the warmest week of the year in western Washington (University of Washington, 2002). Figures 37 and 38 show temperatures recorded from August 1 to 5 in 2000 at the Raging River and Duvall sites. The seven-day average daily maximum temperature from August 1 to 7 in 2000 (Table 5) ranged from 18.4° to 20.5°C, exceeding the 17.8°C threshold for "degraded" water quality for salmonid rearing as defined by the Snohomish Basin Salmonid Recovery Technical Committee. The seven-day average daily maximum temperature from August 1 to 7 in 2001 (Table 5) ranged from 16.0 to 17.2°C. Therefore, each site was "moderately degraded" for water quality for salmonid rearing, i.e., within the "moderately degraded" range of 13.9 to 17.8°C (Snohomish Basin Salmonid Recovery Technical Committee, 2002).

Water temperatures at or above 18°C, temperatures dangerous to salmonid survival (Berman, 1998), were recorded for over 300 hours each summer at the Duvall site and at the Tolt River mouth site in 2000 (Table 8). Overall, the water temperatures during the summer months in 2000 and 2001 were in a temperature range that is considered limiting to salmonid rearing (Berman, 1998; Bjornn and Reiser, 1991). The mainstem Snoqualmie River is on the final 1998 303(d) list based on exceedances of the state water quality criterion for temperature (Washington Department of Ecology, 2000). Lack of riparian cover and presence of low gradient causing slow moving water in the channelized lower reaches of the river contribute to elevated temperature. The summer 2000 habitat conditions inventory showed that even where there is a dense riparian canopy, the trees rarely overhang the river by more than 5 feet. The Snoqualmie River is too wide for the riparian vegetation to have a significant shading effect. Clearcutting in headwaters areas of the Snoqualmie Watershed may also be influencing water temperatures in downstream areas (i.e., the lower mainstem Snoqualmie River).